CHAPTER 14 (Odd)

3. a. $(377)(10)\cos 377t = \mathbf{3770 \cos 377t}$

   b. $(754)(0.6)\cos(754t + 20°) = \mathbf{452.4 \cos(754t + 20°)}$

   c. $(\sqrt{2}\,20)(157)\cos(157t - 20°) = \mathbf{4440.63 \cos(157t - 20°)}$

   d. $(-200)(1)\cos(t + 180°) = -200\cos(t + 180°) = \mathbf{200 \cos t}$

5. a. $V_m = I_mR = (0.03\text{ A})(7 \times 10^3\ \Omega) = 210\text{ V}$
   $v = \mathbf{210 \sin 754t}$

   b. $V_m = I_mR = (2 \times 10^{-3}\text{ A})((7 \times 10^3\ \Omega) = 14.8\text{ V}$
   $v = \mathbf{14.8 \sin(400t - 120°)}$

   c. $i = 6 \times 10^{-6}\sin(\omega t - 2° + 90°) = 6 \times 10^{-6}\sin(\omega t + 88°)$
   $V_m = I_mR = (6 \times 10^{-6}\text{ A})((7 \times 10^3\ \Omega) = 42 \times 10^{-3}\text{ V}$
   $v = \mathbf{42 \times 10^{-3} \sin(\omega t + 88°)}$

   d. $i = 0.004\sin(\omega t - 90° + 90° + 180°) = 0.004\sin(\omega t + 180°)$
   $V_m = I_mR = (4 \times 10^{-3}\text{ A})((7 \times 10^3\ \Omega) = 28\text{ V}$
   $v = \mathbf{28 \sin(\omega t + 180°)}$

7. a. $L = \dfrac{X_L}{2\pi f} = \dfrac{20\ \Omega}{2\pi(2\text{ Hz})} = \mathbf{1.592\text{ H}}$

   b. $L = \dfrac{X_L}{2\pi f} = \dfrac{1000\ \Omega}{2\pi(60\text{ Hz})} = \mathbf{2.654\text{ H}}$

   c. $L = \dfrac{X_L}{2\pi f} = \dfrac{5280\ \Omega}{2\pi(1000\text{ Hz})} = \mathbf{0.841\text{ H}}$

9. a. $V_m = I_mX_L = (5\text{ A})(20\ \Omega) = 100\text{ V}$
   $v = \mathbf{100 \sin(\omega t + 90°)}$

   b. $V_m = I_mX_L = (0.4\text{ A})(20\ \Omega) = 8\text{ V}$
   $v = \mathbf{8 \sin(\omega t + 150°)}$

   c. $i = 6\sin(\omega t + 150°)$, $V_m = I_mX_L = (6\text{ A})(20\ \Omega) = 120\text{ V}$
   $v = 120\sin(\omega t + 240°) = \mathbf{120 \sin(\omega t - 120°)}$

   d. $i = 3\sin(\omega t + 100°)$, $V_m = I_mX_L = (3\text{ A})(20\ \Omega) = 60\text{ V}$
   $v = \mathbf{60 \sin(\omega t + 190°)}$

11. a. $I_m = \dfrac{V_m}{X_L} = \dfrac{50\text{ V}}{50\ \Omega} = 1\text{ A}$, $i = \mathbf{1 \sin(\omega t - 90°)}$

   b. $I_m = \dfrac{V_m}{X_L} = \dfrac{30\text{ V}}{50\ \Omega} = 0.6\text{ A}$, $i = \mathbf{0.6 \sin(\omega t - 70°)}$

   c. $v = 40\sin(\omega t + 100°)$
   $I_m = \dfrac{V_m}{X_L} = \dfrac{40\text{ V}}{50\ \Omega} = 0.8\text{ A}$, $i = \mathbf{0.8 \sin(\omega t + 10°)}$

d. $v = 80 \sin(377t + 220°)$

$I_m = \frac{V_m}{X_L} = \frac{80\text{ V}}{50\ \Omega} = 1.6\text{ A}$, $i = \mathbf{1.6 \sin(377t + 130°)}$

13\. a. $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(0\text{ Hz})(5 \times 10^{-6}\text{ F})} = \mathbf{\infty\ \Omega}$

b. $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(60\text{ Hz})(5 \times 10^{-6}\text{ F})} = \mathbf{530.79\ \Omega}$

c. $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(120\text{ Hz})(5 \times 10^{-6}\text{ F})} = \mathbf{265.39\ \Omega}$

d. $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(1800\text{ Hz})(5 \times 10^{-6}\text{ F})} = \mathbf{17.693\ \Omega}$

e. $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi(24 \times 10^3\text{ Hz})(5 \times 10^{-6}\text{ F})} = \mathbf{1.327\ \Omega}$

15\. a. $f = \frac{1}{2\pi CX_C} = \frac{1}{2\pi(50\times10^{-6}\text{ F})(342\ \Omega)} = \mathbf{9.31\text{ Hz}}$

b. $f = \frac{1}{2\pi CX_C} = \frac{1}{2\pi(50\times10^{-6}\text{ F})(684\ \Omega)} = \mathbf{4.66\text{ Hz}}$

c. $f = \frac{1}{2\pi CX_C} = \frac{1}{2\pi(50\times10^{-6}\text{ F})(171\ \Omega)} = \mathbf{18.62\text{ Hz}}$

d. $f = \frac{1}{2\pi CX_C} = \frac{1}{2\pi(50\times10^{-6}\text{ F})(2000\ \Omega)} = \mathbf{1.59\text{ Hz}}$

17\. a. $v = 30 \sin 200t$, $X_C = \frac{1}{\omega C} = \frac{1}{(200)(1 \times 10^{-6})} = 5\text{ k}\Omega$

$I_m = \frac{V_m}{X_C} = \frac{30\text{ V}}{5\text{ k}\Omega} = 6\text{ mA}$, $i = \mathbf{6 \times 10^{-3} \sin(200t + 90°)}$

b. $v = 90 \sin 377t$, $X_C = \frac{1}{\omega C} = \frac{1}{(377)(1 \times 10^{-6})} = 2.65\text{ k}\Omega$

$I_m = \frac{V_m}{X_C} = \frac{90\text{ V}}{2{,}650\ \Omega} = 33.96\text{ mA}$, $i = \mathbf{33.96 \times 10^{-3} \sin(377t + 90°)}$

c. $v = 120 \sin(374t + 210°)$, $X_C = \frac{1}{\omega C} = \frac{1}{(374)(1 \times 10^{-6})} = 2.67\text{ k}\Omega$

$I_m = \frac{V_m}{X_C} = \frac{120\text{ V}}{2{,}670\ \Omega} = 44.94\text{ mA}$, $i = \mathbf{44.94 \times 10^{-3} \sin(374t + 300°)}$

d. $v = 70\sin(800t + 70°)$, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{(800)(1 \times 10^{-6})} = 1.25\text{ k}\Omega$

$I_m = \dfrac{V_m}{X_C} = \dfrac{70\text{ V}}{1250\ \Omega} = 56\text{ mA}$, $i = \mathbf{56 \times 10^{-3}\sin(\omega t + 160°)}$

19. a. $i = 0.2\sin 300t$, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{(300)(0.5 \times 10^{-6})} = 6.67\text{ k}\Omega$

$V_m = I_m X_C = (0.2\text{ A})(6{,}670\ \Omega) = 1334\text{ V}$, $v = \mathbf{1334\sin(300t - 90°)}$

b. $i = 7 \times 10^{-3}\sin 377t$, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{(377)(0.5 \times 10^{-6})} = 5.31\text{ k}\Omega$

$V_m = I_m X_C = (7 \times 10^{-3}\text{ A})(5.31 \times 10^3\ \Omega) = 37.17\text{ V}$

$v = \mathbf{37.17\sin(377t - 90°)}$

c. $i = 0.048\sin(754t + 90°)$, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{(754)(0.5 \times 10^{-6})} = 2.65\text{ k}\Omega$

$V_m = I_m X_C = (48 \times 10^{-3}\text{ A})(2.65 \times 10^3\ \Omega) = 127.2\text{ V}$

$v = \mathbf{127.2\sin 754t}$

d. $i = 80 \times 10^{-3}\sin(1600t - 80°)$, $X_C = \dfrac{1}{\omega C} = \dfrac{1}{(1600)(0.5 \times 10^{-6})} = 1.25\text{ k}\Omega$

$V_m = I_m X_C = (80 \times 10^{-3}\text{ A})(1.25 \times 10^3\ \Omega) = 100\text{ V}$

$v = \mathbf{100\sin(1600t - 170°)}$

21. a. $\left.\begin{array}{l} i = 5\sin(\omega t + 90°) \\ v = 2000\sin\omega t \end{array}\right\}$ i leads v by 90° ⇒ **C**

$X_C = \dfrac{V_m}{I_m} = \dfrac{2000\text{ V}}{5\text{ A}} = 400\ \Omega$

b. $\left.\begin{array}{l} i = 2\sin(157t + 60°) \\ v = 80\sin(157t + 150°) \end{array}\right\}$ v leads i by 90° ⇒ **L**

$X_L = \dfrac{V_m}{I_m} = \dfrac{80\text{ V}}{2\text{ A}} = 40\ \Omega$, $L = \dfrac{X_L}{\omega} = \dfrac{40\ \Omega}{157\text{ rad/s}} = \mathbf{254.78\text{ mH}}$

c. $\left.\begin{array}{l} v = 35\sin(\omega t - 20°) \\ i = 7\sin(\omega t - 20°) \end{array}\right\}$ in phase ⇒ **R**

$R = \dfrac{V_m}{I_m} = \dfrac{35\text{ V}}{7\text{ A}} = \mathbf{5\ \Omega}$

25. $X_L = 2\pi fL = R$

$L = \dfrac{R}{2\pi f} = \dfrac{10{,}000\ \Omega}{2\pi(5 \times 10^3\text{ Hz})} = \mathbf{318.47\text{ mH}}$

27. $X_C = X_L$

$$\frac{1}{2\pi fC} = 2\pi fL \Rightarrow C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{4(9.86)(2500 \times 10^6)(2 \times 10^{-3})} = \mathbf{5.067\ nF}$$

29. a. $P = \frac{V_m I_m}{2} \cos\theta = \frac{(5\ \text{A})(2000\ \text{V})}{2} \cos 90° = \mathbf{0\ W}$

b. $\cos\theta = 0 \Rightarrow \mathbf{0\ W}$

c. $P = \frac{(35\ \text{V})(7\ \text{A})}{2} \cos 0° = \mathbf{122.5\ W}$

31. $R = \frac{V_m}{I_m} = \frac{48\ \text{V}}{8\ \text{A}} = 6\ \Omega,\ P = I^2R = \left[\frac{8\ \text{A}}{\sqrt{2}}\right]^2 6\ \Omega = \mathbf{192\ W}$

$$P = \frac{V_m I_m}{2} \cos\theta = \frac{(48\ \text{V})(8\ \text{A})}{2} \cos 0° = \mathbf{192\ W}$$

$$P = VI\cos\theta = \left[\frac{48\ \text{V}}{\sqrt{2}}\right]\left[\frac{8\ \text{A}}{\sqrt{2}}\right] \cos 0° = \mathbf{192\ W}$$

33. $P = \frac{V_m I_m}{2} \cos\theta$

$$500\ \text{W} = \frac{(50\ \text{V})I_m}{2}(0.5) \Rightarrow I_m = 40\ \text{A}$$

$$i = \mathbf{40\ sin(\omega t - 50°)}$$

35. a. $I_m = \frac{V_m}{X_L} = \frac{100\ \text{V}}{50\ \Omega} = 2\ \text{A},\ i = \mathbf{2\ sin(157t - 60°)}$

b. $X_L = \frac{V_m}{I_m} = \frac{100\ \text{V}}{2\ \text{A}} = 50\ \Omega,\ L = \frac{X_L}{\omega} = \frac{50\ \Omega}{157\ \text{rad/s}} = \mathbf{318.47\ mH}$

c. $L \Rightarrow \mathbf{0\ W}$

37. a. $X_{C_1} = \frac{1}{2\pi fC_1} = \frac{1}{\omega C_1} = \frac{1}{(10^4\ \text{rad/s})(2\ \mu\text{F})} = 50\ \Omega$

$$X_{C_2} = \frac{1}{\omega C_2} = \frac{1}{(10^4)(8\ \mu\text{F})} = 12.5\ \Omega$$

$$\mathbf{E} = 100\ \text{V}\ \angle 60° \quad \mathbf{I}_1 = \frac{\mathbf{E}}{\mathbf{Z}_{C_1}} = \frac{100\ \text{V}\ \angle 60°}{50\ \Omega\ \angle -90°} = 2\ \text{A}\ \angle 150°$$

$$\mathbf{I}_2 = \frac{\mathbf{E}}{\mathbf{Z}_{C_2}} = \frac{100\ \text{V}\ \angle 60°}{12.5\ \Omega\ \angle -90°} = 8\ \text{A}\ \angle 150°$$

$$i_1 = \sqrt{2}\ 2\sin(10^4 t + 150°) = \mathbf{2.828\ sin(10^4 t + 150°)}$$

$$i_2 = \sqrt{2}\ 8\sin(10^4 t + 150°) = \mathbf{11.312\ sin(10^4 t + 150°)}$$

b. $\mathbf{I}_s = \mathbf{I}_1 + \mathbf{I}_2 = 2\ \text{A}\ \angle 150° + 8\ \text{A}\ \angle 150° = 10\ \text{A}\ \angle 150°$

$$i_s = \sqrt{2}\ 10\sin(10^4 t + 150°) = \mathbf{14.14\ sin(10^4 t + 150°)}$$

39.	a.	**$5.0 \angle 36.87°$**	b.	**$2.83 \angle 45°$**	c.	**$16.38 \angle 77.66°$**
	d.	**$806.23 \angle 82.87°$**	e.	**$1077.03 \angle 21.80°$**	f.	**$0.00658 \angle 81.25°$**
	g.	**$11.78 \angle -49.82°$**	h.	**$8.94 \angle 153.43°$**	i.	**$61.85 \angle -104.04°$**
	j.	**$101.53 \angle -39.81°$**	k.	**$4{,}326.66 \angle 123.69°$**	l.	**$25.495 \times 10^{-3} \angle -78.69°$**
41.	a.	**$15.033 \angle 86.19°$**	b.	**$60.208 \angle 4.76°$**	c.	**$0.30 \angle 88.09°$**
	d.	**$2002.5 \angle -87.14°$**	e.	**$86.182 \angle 93.73°$**	f.	**$38.694 \angle -94.0°$**
43.	a.	**$11.8 + j7.0$**	b.	**$151.90 + j49.90$**	c.	**$4.72 \times 10^{-6} + j71$**
	d.	**$5.20 + j1.60$**	e.	**$209.30 + j311.0$**	f.	**$-21.20 + j12.0$**

g. $6 \angle 20° + 8 \angle 80° = (5.64 + j2.05) + (1.39 + j7.88) =$ **$7.03 + j9.93$**

h. $(29.698 + j29.698) + (31.0 + j53.69) - (-35 + j60.62) =$ **$95.698 + j22.768$**

45.	a.	**$6.0 \angle -50.0°$**	b.	**$0.2 \times 10^{-3} \angle 140°$**	c.	**$109.0 \angle -230.0°$**

d. **$76.471 \angle -80.0°$** e. $(11.314 \angle 45°)/(2.828 \angle 45°) =$ **$40 \angle 0°$**

f. $42.76 \angle 79.22°/60.30 \angle 95.71° =$ **$0.71 \angle -16.49°$**

g. $(0.05 + j0.25)/(8 - j60) = 0.255 \angle 78.69°/60.53 \angle -82.41° =$ **$4.21 \times 10^{-3} \angle 161.10°$**

h. $(7.5 \angle -126.87°)/(0.4123 \angle -75.96°) =$ **$18.191 \angle -50.91°$**

47. a.

$$x + j4 + 3x + jy - j7 = 16$$
$$(x + 3x) + j(4 + y - 7) = 16 + j0$$
$$x + 3x = 16 \qquad 4 + y - 7 = 0$$
$$4x = 16 \qquad y = +7 - 4$$
$$x = \mathbf{4} \qquad y = \mathbf{3}$$

b.

$$(10 \angle 20°)(x \angle -60°) = 30.64 - j25.72$$
$$10x \angle -40° = 40 \angle -40°$$
$$10\,x = 40$$
$$x = \mathbf{4}$$

c. $5x + j10$
$2 - jy$

$10x + j20 - j5xy - j^2 10y = 90 - j70$
$(10x + 10y) + j(20 - 5xy) = 90 - j70$
$10x + 10y = 90$ $\qquad$ $20 - 5xy = -70$
$x + y = 9$
$x = 9 - y \Rightarrow$ $\qquad$ $20 - 5(9 - y)y = -70$
$5y(9 - y) = 90$
$y^2 - 9y + 18 = 0$

$$y = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(1)(18)}}{2}$$
$$y = \frac{9 \pm 3}{2} = 6, 3$$

For $y = 6, x = 3$
$y = 3, x = 6$
($x = 3, y = 6$) or ($x = 6, y = 3$)

d. $\dfrac{80 \angle 0°}{40 \angle \theta} = 4 \angle -\theta = 3.464 - j2 = 4 \angle -30°$
$\theta = 30°$

49. a. **$56.569 \sin(377t + 20°)$** b. **$169.68 \sin 377t$**

c. **$11.314 \times 10^{-3} \sin(377t + 120°)$** d. **$7.07 \sin(377t + 90°)$**

e. **$1696.8 \sin(377t - 120°)$** f. **$6000 \sin(377t - 180°)$**

51. $i_s = i_1 + i_2 \Rightarrow i_1 = i_s - i_2$
(Using peak values) $= (20 \times 10^{-6}\text{ A} \angle 90°) - (6 \times 10^{-6}\text{ A} \angle -60°)$
and $i_1 = (0 + j2 \times 10^{-5}) - (3 \times 10^{-6} - j5.196 \times 10^{-6})$
$= -0.3 \times 10^{-5} + j2.5196 \times 10^{-5} = 2.537 \times 10^{-5} \angle 96.79°$
$= 2.537 \times 10^{-5} \sin(\omega t + 96.79°)$

53. (Using effective values)

$\mathbf{I}_s = \mathbf{I}_1 + \mathbf{I}_2 + \mathbf{I}_3 = 4.240\text{ mA} \angle 180° + 5.656\text{ mA} \angle 0° + 11.312\text{ mA} \angle 0°$
$= -4.242\text{ mA} + 16.968\text{ mA} = 12.726\text{ mA} \angle 0°$
$i_s = 18 \times 10^{-3} \sin 377t$

CHAPTER 14 (Even)

4. a. $I_m = V_m/R = 150 \text{ V}/5\ \Omega = 30 \text{ A},\ i = \mathbf{30 \sin 377t}$

   b. $I_m = V_m/R = 30 \text{ V}/5\ \Omega = 6 \text{ A},\ i = \mathbf{6 \sin(377t + 20°)}$

   c. $I_m = V_m/R = 40 \text{ V}/5\ \Omega = 8 \text{ A},\ i = \mathbf{8 \sin(\omega t + 100°)}$

   d. $I_m = V_m/R = 80 \text{ V}/5\ \Omega = 16 \text{ A},\ i = \mathbf{16 \sin(\omega t + 220°)}$

6. a. **0 Ω**

   b. $X_L = 2\pi fL = 2\pi Lf = (6.28)(2 \text{ H})f = 12.56f = 12.56(25 \text{ Hz}) = \mathbf{314\ \Omega}$

   c. $X_L = 12.56f = 12.56(60 \text{ Hz}) = \mathbf{753.6\ \Omega}$

   d. $X_L = 12.56f = 12.56(2000 \text{ Hz}) = \mathbf{25.13\ k\Omega}$

   e. $X_L = 12.56f = 12.56(10^5 \text{ Hz}) = \mathbf{1.256\ M\Omega}$

8. a. $X_L = 2\pi fL \Rightarrow f = \dfrac{X_L}{2\pi L} = \dfrac{X_L}{(6.28)(10 \text{ H})} = \dfrac{X_L}{62.8}$

   $f = \dfrac{50\ \Omega}{62.8} \cong \mathbf{0.796\ Hz}$

   b. $f = \dfrac{X_L}{62.8} = \dfrac{3770\ \Omega}{62.8} = \mathbf{60.03\ Hz}$

   c. $f = \dfrac{X_L}{62.8} = \dfrac{15{,}700\ \Omega}{62.8} = \mathbf{250\ Hz}$

   d. $f = \dfrac{X_L}{62.8} = \dfrac{243\ \Omega}{62.8} = \mathbf{3.87\ Hz}$

10. a. $X_L = \omega L = (300 \text{ rad/s})(0.1 \text{ H}) = 3\ \Omega$
    $V_m = I_m X_L = (30 \text{ A})(3\ \Omega) = 90 \text{ V}$
    $v = \mathbf{90 \sin(30t + 90°)}$

    b. $X_L = \omega L = (377 \text{ rad/s})(0.1 \text{ H}) = 37.7\ \Omega$
    $V_m = I_m X_L = (6 \times 10^{-3} \text{ A})(37.7\ \Omega) = 226.2 \text{ mV}$
    $v = \mathbf{226.2 \times 10^{-3} \sin(377t + 90°)}$

    c. $X_L = \omega L = (400 \text{ rad/s})(0.1 \text{ H}) = 40\ \Omega$
    $V_m = I_m X_L = (5 \times 10^{-6} \text{ A})(40\ \Omega) = 200\ \mu\text{V}$
    $v = \mathbf{200 \times 10^{-6} \sin(400t + 110°)}$

    d. $i = 4 \sin(20t + 200°)$
    $X_L = \omega L = (20 \text{ rad/s})(0.1 \text{ H}) = 2\ \Omega$
    $V_m = I_m X_L = (4 \text{ A})(2\ \Omega) = 8 \text{ V}$
    $v = 8 \sin(20t + 290°) = \mathbf{8 \sin(20t - 70°)}$

12. a. $X_L = \omega L = (60 \text{ rad/s})(0.2 \text{ H}) = 12\ \Omega$
$I_m = V_m/X_L = 1.5 \text{ V}/12\ \Omega = 0.125 \text{ A}$
$i = \mathbf{0.125 \sin(60t - 90°)}$

b. $X_L = \omega L = (1 \text{ rad/s})(0.2 \text{ H}) = 0.2\ \Omega$
$I_m = V_m/X_L = 16 \text{ mV}/0.2\ \Omega = 80 \text{ mA}$
$i = 80 \times 10^{-3} \sin(t + 4° - 90°) = \mathbf{80 \times 10^{-3} \sin(t - 86°)}$

c. $v = 4.8 \sin(0.05t + 230°)$
$X_L = \omega L = (0.05 \text{ rad/s})(0.2 \text{ H}) = 0.01\ \Omega$
$I_m = V_m/X_L = 4.8 \text{ V}/0.01\ \Omega = 480 \text{ A}$
$i = 480 \sin(0.05t + 230° - 90°) = \mathbf{480 \sin(0.05t + 140°)}$

d. $v = 9 \times 10^{-3} \sin(377t + 90°)$
$X_L = \omega L = (377 \text{ rad/s})(0.2 \text{ H}) = 75.4\ \Omega$
$I_m = V_m/X_L = 9 \text{ mV}/75.4\ \Omega = 0.119 \text{ mA}$
$i = \mathbf{0.119 \times 10^{-3} \sin 377t}$

14. a. $$C = \frac{1}{2\pi f X_C} = \frac{1}{6.28(60 \text{ Hz})(250\ \Omega)} = \mathbf{10.62\ \mu F}$$

b. $$C = \frac{1}{2\pi f X_C} = \frac{1}{6.28(312 \text{ Hz})(55\ \Omega)} = \mathbf{9.28\ \mu F}$$

c. $$C = \frac{1}{2\pi f X_C} = \frac{1}{6.28(25 \text{ Hz})(10\ \Omega)} = \mathbf{636.94\ \mu F}$$

16. a. $I_m = V_m/X_C = 100 \text{ V}/2.5\ \Omega = 40 \text{ A}$
$i = \mathbf{40 \sin(\omega t + 90°)}$

b. $I_m = V_m/X_C = 0.4 \text{ V}/2.5\ \Omega = 0.16 \text{ A}$
$i = \mathbf{0.16 \sin(\omega t + 110°)}$

c. $v = 8 \sin(\omega t + 100°)$
$I_m = V_m/X_C = 8 \text{ V}/2.5\ \Omega = 3.2 \text{ A}$
$i = \mathbf{3.2 \sin(\omega t + 190°)}$

d. $v = -70 \sin(\omega t + 40°) = 70 \sin(\omega t + 220°)$
$I_m = V_m/X_C = 70 \text{ V}/2.5\ \Omega = 28 \text{ A}$
$i = 28 \sin(\omega t + 310°) = \mathbf{28 \sin(\omega t - 50°)}$

18. a. $V_m = I_m X_C = (50 \text{ A})(10\ \Omega) = 500 \text{ V}$
$v = \mathbf{500 \sin(\omega t - 90°)}$

b. $V_m = I_m X_C = (40 \text{ A})(10\ \Omega) = 400 \text{ V}$
$v = \mathbf{400 \sin(\omega t - 30°)}$

c. $i = -6 \sin(\omega t - 30°) = 6 \sin(\omega t + 150°)$
$V_m = I_m X_C = (6 \text{ A})(10\ \Omega) = 60 \text{ V}$
$v = \mathbf{60 \sin(\omega t + 60°)}$

d. $i = 3 \sin(\omega t + 100°)$
$V_m = I_m X_C = (3 \text{ A})(10\ \Omega) = 30 \text{ V}$
$v = \mathbf{30 \sin(\omega t + 10°)}$

20. a. v leads i by $90° \Rightarrow L$, $X_L = V_m/I_m = 550 \text{ V}/11 \text{ A} = 50\ \Omega$
$$L = \frac{X_L}{\omega} = \frac{50\ \Omega}{377 \text{ rad/s}} = \mathbf{132.63 \text{ mH}}$$

b. i leads v by $90° \Rightarrow C$, $X_C = V_m/I_m = 36\text{ V}/4\text{ A} = 9\ \Omega$

$$C = \frac{1}{\omega X_C} = \frac{1}{(754\text{ rad/s})(9\ \Omega)} = \mathbf{147.36\ \mu F}$$

c. v and i are in phase $\Rightarrow R$

$$R = \frac{V_m}{I_m} = \frac{10.5\text{ V}}{1.5\text{ A}} = \mathbf{7\ \Omega}$$

24. $X_C = \dfrac{1}{2\pi fC} = R \Rightarrow f = \dfrac{1}{2\pi RC} = \dfrac{1}{2\pi(2\times 10^3\ \Omega)(1\times 10^{-6}\text{ F})} = \dfrac{1}{12.56\times 10^{-3}}$
$\cong \mathbf{79.62\ Hz}$

26. $X_C = X_L$

$$\frac{1}{2\pi fC} = 2\pi fL$$

$$f^2 = \frac{1}{4\pi^2 LC}$$

and $f = \dfrac{1}{2\pi\sqrt{LC}} = \dfrac{1}{2\pi\sqrt{(10\times 10^{-3}\text{ H})(1\times 10^{-6}\text{ F})}} = \mathbf{1.592\ kHz}$

28. a. $P = \dfrac{V_m I_m}{2}\cos\theta = \dfrac{(550\text{ V})(11\text{ A})}{2}\cos 90° = (\ )(0) = \mathbf{0\ W}$

b. $P = \dfrac{V_m I_m}{2}\cos\theta = \dfrac{(36\text{ V})(4\text{ A})}{2}\cos 90° = (\ )(0) = \mathbf{0\ W}$

c. $P = \dfrac{V_m I_m}{2}\cos\theta = \dfrac{(10.5\text{ V})(1.5\text{ A})}{2}\cos 0° = \mathbf{7.875\ W}$

30. a. $P = \dfrac{(60\text{ V})(15\text{ A})}{2}\cos 30° = \mathbf{389.7\ W}$, $F_p = \mathbf{0.866}$

b. $P = \dfrac{(50\text{ V})(2\text{ A})}{2}\cos 60° = \mathbf{25\ W}$, $F_p = \mathbf{0.5}$

c. $P = \dfrac{(50\text{ V})(3\text{ A})}{2}\cos 30° = \mathbf{64.95\ W}$, $F_p = \mathbf{0.866}$

d. $P = \dfrac{(75\text{ V})(0.08\text{ A})}{2}\cos 30° = \mathbf{2.598\ W}$, $F_p = \mathbf{0.866}$

32. $P = 100\text{ W}$: $F_p = \cos\theta = P/VI = 100\text{ W}/(150\text{ V})(2\text{ A}) = \mathbf{0.333}$
$P = 0\text{ W}$: $F_p = \cos\theta = \mathbf{0}$
$P = 300\text{ W}$: $F_p = \dfrac{300}{300} = \mathbf{1}$

34. a. $I_m = E_m/R = 30\text{ V}/3\ \Omega = 10\text{ A}$, $i = \mathbf{10\sin(377t + 20°)}$

b. $P = I^2R = \left[\frac{10\text{ A}}{\sqrt{2}}\right]^2 3\ \Omega = \mathbf{150\ W}$

c. $T = \frac{2\pi}{\omega} = \frac{6.28}{377\text{ rad/s}} = \mathbf{16.67\ ms}$

$6(16.67\text{ ms}) = 100.02\text{ ms} \cong \mathbf{0.1\ s}$

36. a. $E_m = I_mX_C = (3\text{ A})(400\ \Omega) = 1200\text{ V}$

$e = 1200\sin(377t - 20° - 90°) = \mathbf{1200\sin(377t - 110°)}$

b. $C = \frac{1}{\omega X_C} = \frac{1}{(377\text{ rad/s})(400\ \Omega)} = \mathbf{6.63\ \mu F}$

c. $P = 0\text{ W}$

38. a. $L_1 \| L_2 = 4\text{ mH} \| 12\text{ mH} = 3\text{ mH}$

$X_{L_T} = 2\pi f L_T = 2\pi(10^3\text{ Hz})(3\text{ mH}) = 18.84\ \Omega$

$V_m = I_mX_{L_T} = (\sqrt{2}\ 6\text{ A})(18.84\ \Omega) = \sqrt{2}\ 113.04\text{ V}$

and $v_s = \sqrt{2}\,113.04\sin(10^3t + 30° + 90°)$

or $v_s = \mathbf{159.86\sin(10^3t + 120°)}$

b. $I_{m_1} = \frac{V_m}{X_{L_1}}$, $X_{L_1} = 2\pi f L_1 = 2\pi(10^3\text{ Hz})(4\text{ mH}) = 25.13\ \Omega$

$I_{m_1} = \frac{159.86\text{ V}}{25.13\ \Omega} = 6.36\text{ A}$

and $i_1 = \mathbf{6.36\sin(10^3t + 30°)}$

$X_{L_2} = 2\pi f L_2 = 2\pi(10^3\text{ Hz})(12\text{ mH}) = 75.398\ \Omega$

$I_{m_2} = \frac{159.86\text{ V}}{75.398\ \Omega} = 2.12\text{ A}$

and $i_2 = \mathbf{2.12\sin(10^3t + 30°)}$

40. a. **5.196 + *j*3.0** b. **6.946 + *j*39.392**

c. **2530.95 + *j*6953.73** d. $\mathbf{3.961 \times 10^{-4} + j5.567 \times 10^{-5}}$

e. **0.007 + *j*0.039** f. $\mathbf{8.561 \times 10^{-3} + j3.634 \times 10^{-3}}$

g. **−56.292 + *j*32.50** h. **−0.849 + *j*0.849**

i. **−469.846 − *j*171.01** j. **5177.04 − *j*3625.0**

k. **−4.313 − *j*6.160** l. **0.005142 − *j*0.006128**

42. a. **12.951 + *j*1.133** b. **8.374 + *j*159.781**

c. $\mathbf{6.996 \times 10^{-6} + j2.443 \times 10^{-7}}$ d. **−8.688 + *j*0.455**

e. **75.815 − *j*5.301** f. **−34.514 − *j*394.493**

44. a. **−12.0 + *j*34.0** b. (29.2 + *j*19.6)(7 + *j*6) = **86.80 + *j*312.40**

c. **−0.0160 − *j*0.008**

d. $(447.214 \angle -26.565°)(0.5 \angle -91.146°)(3.162 \angle 108.435°) = \mathbf{707.045 \angle -9.276°}$

e. $\mathbf{8.0 \angle 82.0°}$ f. $\mathbf{49.68 \angle -64.0°}$

g. $\mathbf{0.040 \angle 260°}$ h. $\mathbf{-16{,}740 \angle 160°}$

46. a. $\dfrac{10 - j5}{1 + j0} = \mathbf{10.0 - j5.0}$

b. $\dfrac{8 \angle 60°}{102 + j100} = \dfrac{8 \angle 60°}{142.843 \angle 44.433°} = \mathbf{0.056 \angle 15.567°}$

c. $\dfrac{(6 \angle 20°)(120 \angle -40°)(5 \angle 53.13°)}{2 \angle -30°} = \dfrac{3600 \angle 33.13°}{2 \angle -30°} = \mathbf{1800 \angle 63.13°}$

d. $\dfrac{(0.16 \angle 120°)(300 \angle 40°)}{9.487 \angle 71.565°} = \dfrac{48 \angle 160°}{9.487 \angle 71.565°} = \mathbf{5.06 \angle 88.435°}$

e. $\left[\dfrac{1}{4 \times 10^{-4} \angle 20°}\right]\left[\dfrac{8}{j(j^2)}\right]\left[\dfrac{1}{36 - j30}\right]$

$(2500 \angle -20°)\left[\dfrac{8}{-j}\right]\left[\dfrac{1}{46.861 \angle -39.81°}\right]$

$(2500 \angle -20°)(8j)(0.0213 \angle 39.81°) = \mathbf{426 \angle 109.81°}$

48. a. $\mathbf{100.0 \angle 30°}$ b. $\mathbf{0.250 \angle -40°}$

c. $\mathbf{70.71 \angle -90°}$ d. $\mathbf{29.69 \angle 0°}$

e. $\mathbf{4.242 \times 10^{-6} \angle 90°}$ f. $\mathbf{2.546 \times 10^{-6} \angle 70°}$

50. (Using peak values)

$$\begin{aligned} e_{in} = v_a + v_b \Rightarrow v_a &= e_{in} - v_b \\ &= 60\text{ V} \angle 20° - 20\text{ V} \angle 0° \\ &= (56.381 + j20.521) - (20 + j0) \\ &= 36.381 + j20.52 \\ &= 41.769\text{ V} \angle 29.43° \end{aligned}$$

and $e_{in} = \mathbf{41.769 \sin(377t + 29.43°)}$

52.

$$\begin{aligned} e &= v_a + v_b + v_c \\ &= 60\text{ V} \angle 30° + 30\text{ V} \angle -30° + 40\text{ V} \angle 120° \\ &= (51.96 + j30) + (25.98 - j15) + (-20 + j34.64) \\ &= 57.94 + j49.64 \\ &= 76.297\text{ V} \angle 40.59° \end{aligned}$$

and $e = \mathbf{76.297 \sin(\omega t + 40.59°)}$